The Babcock Test for Fat in Milk

By O. R. Overman and O. F. Garrett

THE BABCOCK test is the most satisfactory and practical rapid method for determining the percentage of butterfat in milk. The method depends on the action of strong sulfuric acid and of centrifugal force on the components of the product to be tested. The sulfuric acid does at least three things:

1. It acts upon the solids other than fat of the product in such manner as to allow the fat to separate more easily from them.

2. Its action with the water and the solids of the product produces so much heat that the fat-globules melt and tend to flow together.

3. The acid is much heavier than milk and greatly increases the difference in specific gravity between the fat and the liquid mixture surrounding it.

After the action of the acid is complete, centrifugal force is used to separate the fat from the heavy mixture.

The equipment necessary to make the Babcock test for fat in milk is illustrated below.

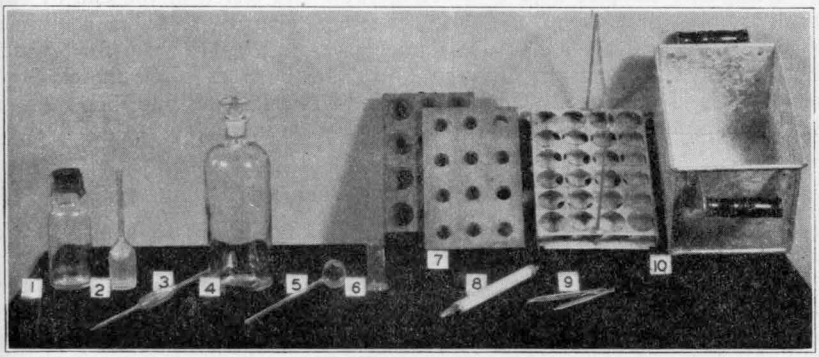

Fig. 1.—Equipment Used in Babcock Test for Fat in Milk

(1) Rubber-stoppered sample bottle, (2) milk testing bottle,[1] (3) 17.6 cc. pipette, (4) glass-stoppered bottle of commercial sulfuric acid having a specific gravity between 1.83 and 1.82, (5) 17.5 cc. acid dipper, (6) 17.5 cc. acid cylinder, (7) test bottle block and cover (wood block 1½ x 5½ x 9 in. with 12 holes 1½ in. diameter and 1¼ in. deep; cover ⅝ x 5½ x 9 in. with 12 holes ⅞ in. diameter), (8) floating dairy thermometer, (9) dividers, (10) water bath and tray (pan 6¾ x 10 x 6½ in. deep of galvanized sheet metal; tray of same material with 24 holes 1½ in. diameter).

[1]Section 20 of the *Illinois Dairy and Food Law* says, "The State standard test tubes or bottles for milk shall have a capacity of two cubic centimeters at a temperature of sixty degrees Fahrenheit between 'zero' and ten on the graduated scale marked on the necks thereof."

University of Illinois, College of Agriculture and Agricultural Experiment Station, Urbana. Circular 390, April, 1932.

Taking Sample for Testing

A sample must be obtained that correctly represents the composition of the entire amount of milk to be tested. The milk, therefore, must be thoroly mixed just before sampling. This is done by pouring the milk from one vessel to another several times or by vigorous, thoro stirring. The sample is then taken with a small dipper or a sampling tube.

At milk plants where the number of patrons is large, sampling and testing of the daily deliveries of each patron are impractical. Instead, a composite sample is obtained by mixing equal aliquot portions taken daily for several days from the milk delivered by one patron. The daily sample may be taken from the milk after it has been poured into the weighing can. It should immediately be put in the sample jar. Samples are usually taken with a small dipper, and altho such samples are not exactly equal aliquots, they approximate aliquot portions nearly enough for practical use in the milk plant.

Composite samples should be kept with a preservative (one tablet of corrosive sublimate or 1 cc. of formalin will prevent the souring of a pint sample for a week or more) in tightly stoppered containers in a cool place, preferably a refrigerator. The contents of each container should be mixed daily by gentle shaking.

Composite samples kept in a refrigerator and tested at the end of one week are usually in such a condition that simple pouring from one container to another several times is all that is necessary to prepare them for testing. If, however, spots or rings of cream adhere to the sides of the sample jars, set the jars in water at 100° to 110° F. for a few minutes and then remove the adhering cream with a rubber scraper before mixing.

Procedure for Testing Whole Milk

1. Mix the sample (which should be at 50° to 70° F.) by pouring back and forth from one sample bottle to another several times.

2. Immediately after mixing, draw the milk above the mark on the large stem of the 17.6 cc. pipette. Place the ball of the forefinger on the opening at the top and let the milk flow back into the sample until the bottom of the curved surface of the milk is exactly at the mark. Then allow the milk to flow into the testing bottle. This may be done by holding the bottle in a slanting position or, if the delivery tube is long enough, by inserting it completely thru the bottle neck. Blow out the last drop.

3. Measure 17.5 cc. of the sulfuric acid with an acid dipper or cylinder. Pour into the test bottle, rotating the bottle, which is held at an angle of about 45° from the vertical, thus causing the acid to flow down the bottle neck and wash any adhering milk down into the body of the bottle. Be careful that all the acid flows down the side of the bottle and none of it directly thru the milk.

4. Mix the acid and milk with a rotary motion of the bottle; let stand 2 or 3 minutes and mix again.

5. Place the bottles in a tester. Use an even number of bottles and make sure they are so placed that the machine is balanced.

6. Whirl 5 minutes at the speed indicated for the tester used. Add water at 140° F. or warmer to the base of the neck and whirl 2 minutes.

Add warm water again to fill almost to the top mark on the neck and whirl 1 minute. *Do not start timing until the tester has attained the proper speed.*

7. Remove test bottles to a water bath containing water at 140° F. deep enough to cover the top mark on the bottles. Leave the bottles in the hot water for at least 5 minutes to make sure that the fat is at the correct temperature for reading. The temperature of the water in the bath must be between 135° and 140° F. when the tests are read.

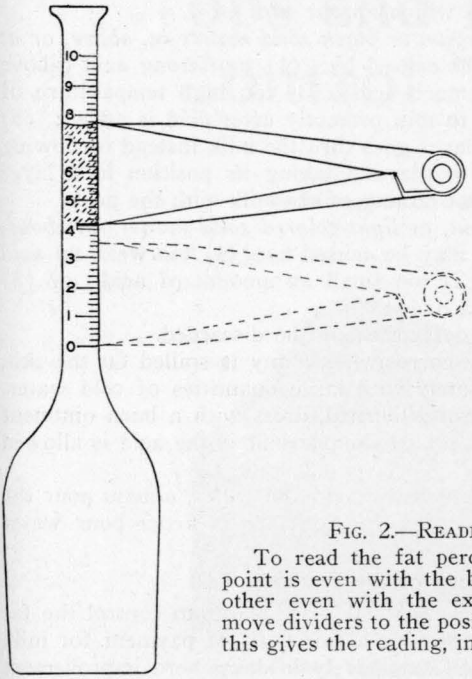

FIG. 2.—READING PERCENTAGE OF FAT

To read the fat percentage, place the dividers so one point is even with the bottom of the fat column and the other even with the extreme top of the column. Then move dividers to the position indicated by the broken lines; this gives the reading, in this case 3.5 percent.

8. Remove one bottle at a time from the water bath and read the percentage of fat immediately.

9. To read the fat percentage, measure the fat column as in Fig. 2, by placing one point of the dividers even with the bottom of the fat column and the other point even with the extreme top of the column. Then, without changing the distance between the points of the dividers, place one point on the zero mark on the bottle—the other point will indicate the percentage of fat.

10. Empty the bottles by inverting and shaking to loosen the white deposit that has collected in the bottom. Rinse with hot water and wash with a hot solution of washing powder, using a bottle brush. Rinse again with hot water to remove the washing-powder solution.

Observations and Precautions

1. Distilled water or clean rain water is best to use in filling the bottles. Hard water may cause foam to form at the top of the fat. If, however, a

few drops of sulfuric acid are added to hard water, it may then be used to fill the bottles.

2. Sulfuric acid exposed to the air absorbs moisture and becomes so diluted that it does not give good tests. It is therefore necessary to keep the acid in tightly closed vessels. Glass-stoppered bottles are very satisfactory.

3. The fat should be a clear straw-yellow-to-amber color. The division between the fat and the acid solution below it should be sharp and distinct.

4. The most common defects which appear are:

(a) A dark fat column or brown or black solid matter in, above, or at the base of the fat. This may be caused by: (1) too strong acid (above 1.83 specific gravity); (2) too much acid; (3) too high temperature of milk, acid, or both; (4) failure to mix promptly after acid is added; (5) adding the acid in such a way that it goes thru the milk instead of flowing down the inside surface of the bottle and taking its position in a layer below the milk; or (6) insufficient mixing of the milk with the acid.

(b) A pale, cloudy fat column, or light-colored solid matter in, above, or at the base of the fat. This may be caused by: (1) too weak an acid (below 1.82 specific gravity); (2) too small an amount of acid; or (3) too low temperature of milk, acid, or both.

Tests showing any of these defects should be discarded.

5. Sulfuric acid is extremely corrosive. If any is spilled on the skin or on clothing, wash off immediately with large quantities of cold water. After washing, if the skin or flesh is burned, dress with a burn ointment and consult a physician. Very bad burns may result if the acid is allowed to remain on the skin.

Should it be necessary to mix sulfuric acid and water, *always* pour the acid slowly into the water stirring at the same time; *never* pour water into the acid.

Some Applications of the Babcock Test

The Babcock test is used in commercial dairy plants to control the fat content of their products and to provide a fair basis of payment for milk delivered to the plants. It is used extensively in dairy herd improvement associations to ascertain the fat production of the individual cows in the herds. It may be used for the same purpose without much expense or inconvenience by farmers to whom dairy herd improvement associations are not available.

Using the Test on the Farm

In order to determine the butterfat production of a cow it is necessary to know the weight of the milk produced and to test the milk at regular intervals. The milk is weighed after each milking, and samples taken, usually once a month, from each milking during a twenty-four hour period. These samples are tested for fat. The weight of the fat calculated from the weight of the milk produced during each month and the fat test taken on one or two days near the middle of the month has been shown by many trials to be very close to the actual amount of fat produced.

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